pnn2 studies on $K^+ \to \pi^+\pi^\circ$ Target Scatters

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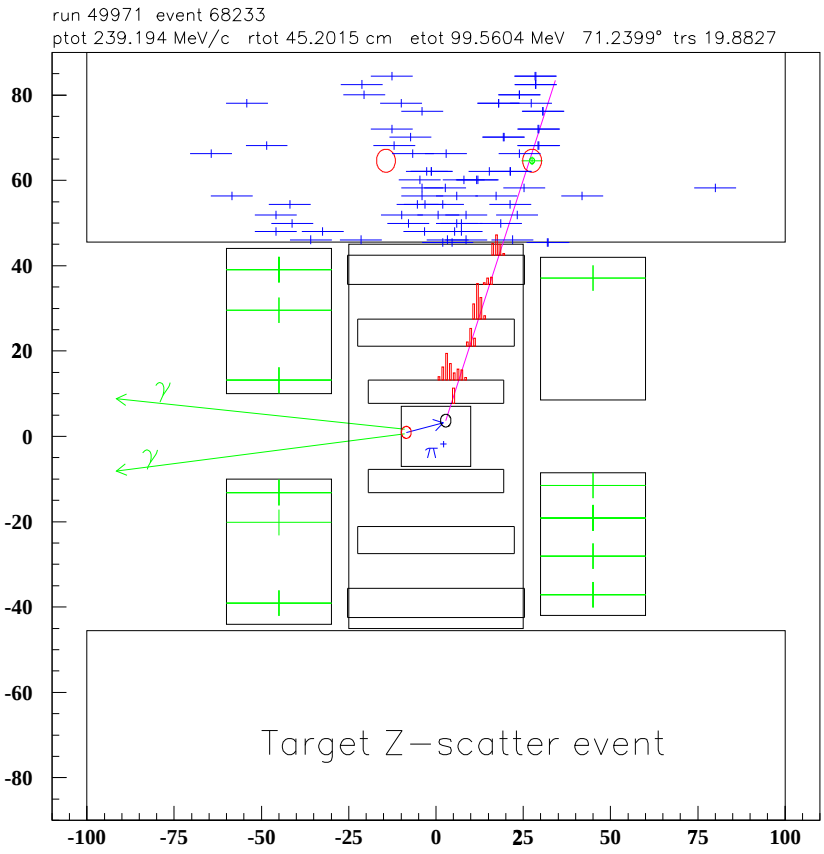
Modivation for $K^+ \to \pi^+\pi^\circ$ -scatter studies

- As seen in e787, Target $K_{\pi 2}$-scatters is the dominant background ($\sim 70\%$).



$TGrecon$ Algorithm

- Reasons to create a new $SWATHccd$ algorithm:
  - Allow KINKs in the target π track.
- Differences between $TGrecon$ and $SWATHccd$
  - $TGrecon$ uses a $swath$ as a criteria for picking the best K/π match. $SWATHccd$ is highly dependent on the UTC track $swath$.
  - Late Ks (> 8ns) have the same 'weight' during K/π matching.
  - $TGrecon$ allows for quicker improvements due to modular design.
- Similiarities between $TGrecon$ and $SWATHccd$
  - Good agreement in TG quantities.
- Improvements
  - $TGrecon$

    Opposite-side Pion problem.

    Apply Swath-Likilyhood function to tracks with kinks.

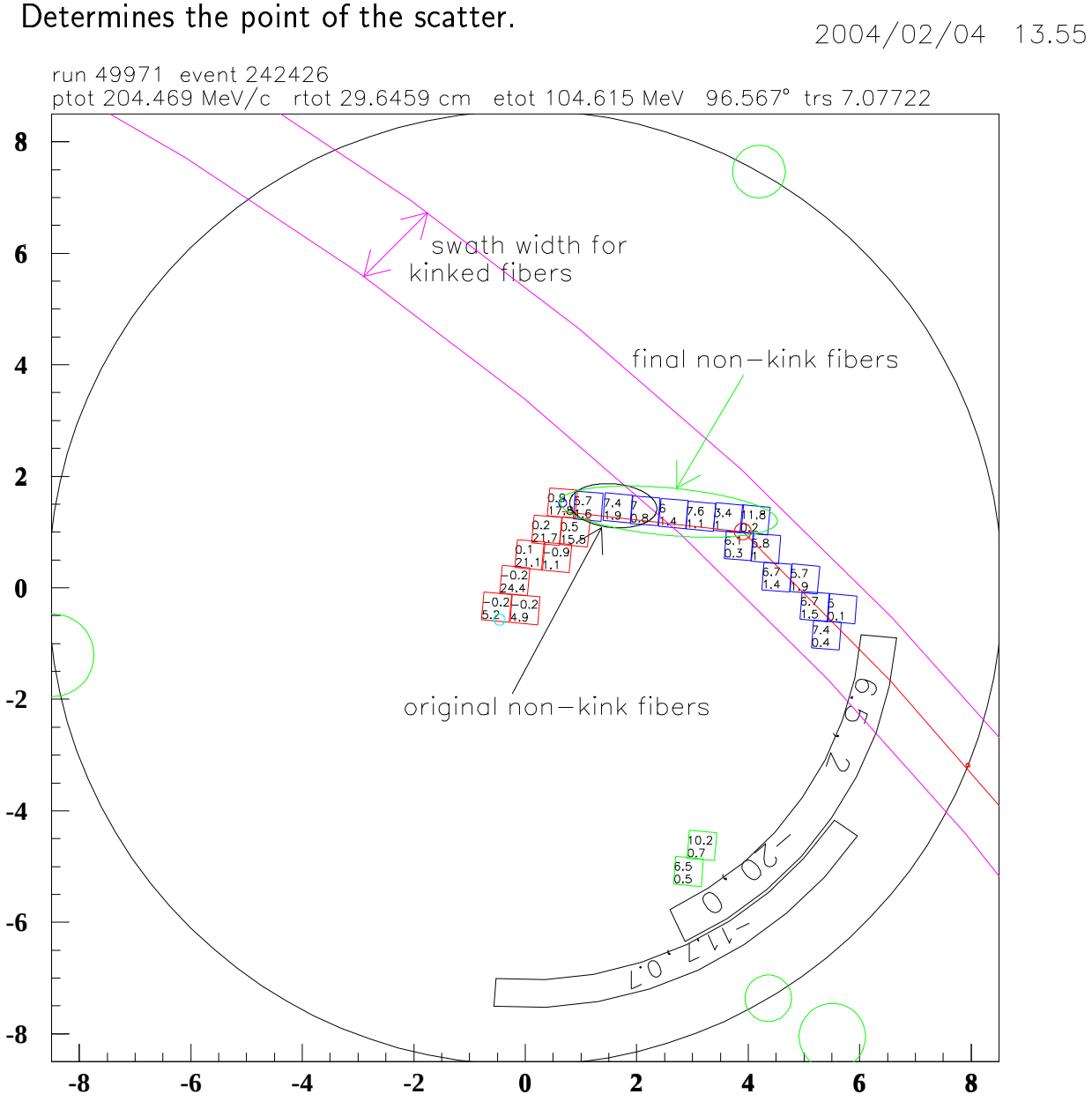
    further improves TGrecon emulation of Swath.

Kink Finding Algorithm

- How $KinkFinder$ works.
  - Classifies π fibers as kinked or non-kinked.
  - Does Least-squares fit on non-kinked fibers.
  - Requirements:

    Must have ≥ 2 fibers off swath (swath = 0.8cm)
    Pass a minimum angle threshold ($\sim 7°$).
  - Fit a track to the non-kinked fibers.

- Improvements to $KinkFinder$.
  - Improved routine to order the fibers.
    Determines the point of the scatter.



$KinkFinder$ Efficiency

- Use a $K_{\mu 2}$ event to determine $false$ kink rate.
  - We don't expect the μ from $K_{\mu 2}$ to scatter in the target.
    So any kinks flaged by $KinkFinder$ as a scatter will mostly likely be wrong.
  - Setup Cuts: PS Cuts (mod for Kinks)

    Flagged as kink.

    Reconstructed by $SWATHccd$ / $TGrecon$.

    $(T_\pi - T_K) > 6$
  - Tighter Cuts:

    $220 < ptot < 260$

    $etot > 140$

Improvements in Red

Real Kinks founded by visual examination.

small set	Sample	Flagged as Kink	Real Kinks	False Kinks
$K_{\mu 21}$	7625	69 (44)	-	0.9% (0.6%)
TG reconstructed	7120	62	-	0.9%
Setup cuts	4288 (3245)	21 (4)	3 (2)	0.4% (0.06%)
w/Tight cuts	2858 (584)	7 (1)	2 (1)	0.2% (0.0%)

Kinks in pnn2 data

- e787 $K_{\pi 2}$ -scatter background
  - Used 17 classes of events inside the $K_{\pi 2}$ -BOX or PNN2-BOX regions with various cuts applied. Generally, CCDPUL or 567 was inverted.

    CCDPUL - find extra energy in kaon fibers at π time.

    CHI567 - is the probability from the target track fitting program.

Description	CLASS 7	CLASS 9	ONEBEAM
NO CCD FIT	1	-	-
K Decay in IC	1	4	-
T_π inconsistent	1*	1*	-
Kink in π^+ track	3	7	-
π^+ scatter under K	-	6	-
Gap in π^+ fibers	-	2	-
$T_\pi < T_K$	-	-	1
Prompt K decay	-	-	4
Totals	6	21	5

* = same event

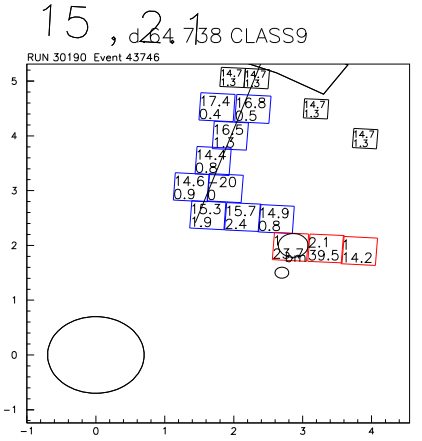


Figure 1: Run 30190, event 43746 shows a clear kink in the pion fibers. From the response of the CCDs shown in figure 2, it is clear that the pion track traverses the three kaon fibers before scattering.

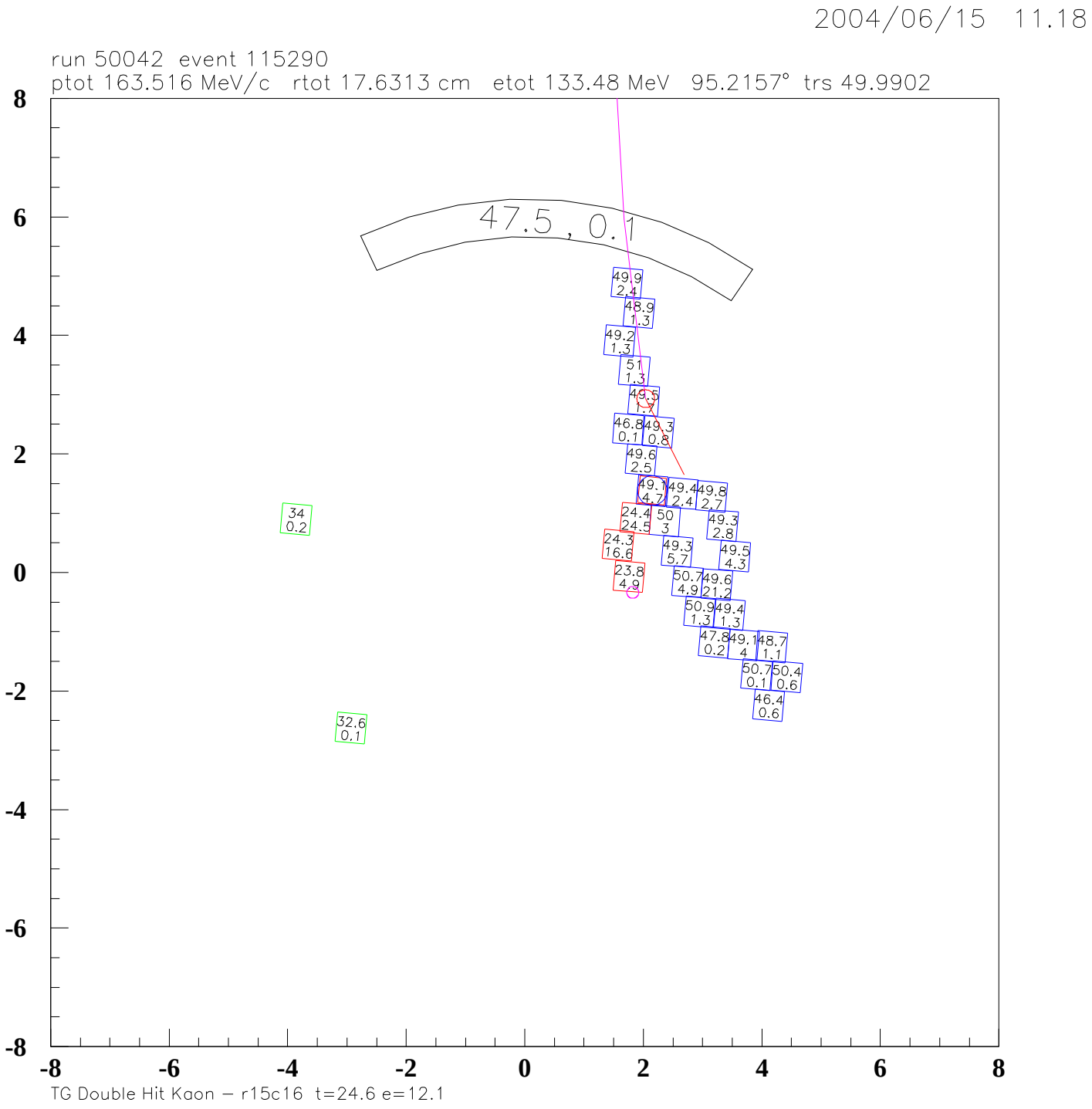
- e949 1/3 Pass1 output
- Using $SWATHccd$ as the main reconstuctor $TGrecon$ tries when $SWATHccd$ fails.

	Sample	Flagged as Kink	Kinks
pass1 output	1219035 (337524)	7364 (6221)	0.6% (1.8%)
TG reconstructed	861137	6675	0.8%
Setup cuts	377735 (28166)	1787 (253)	0.5% (0.9%)

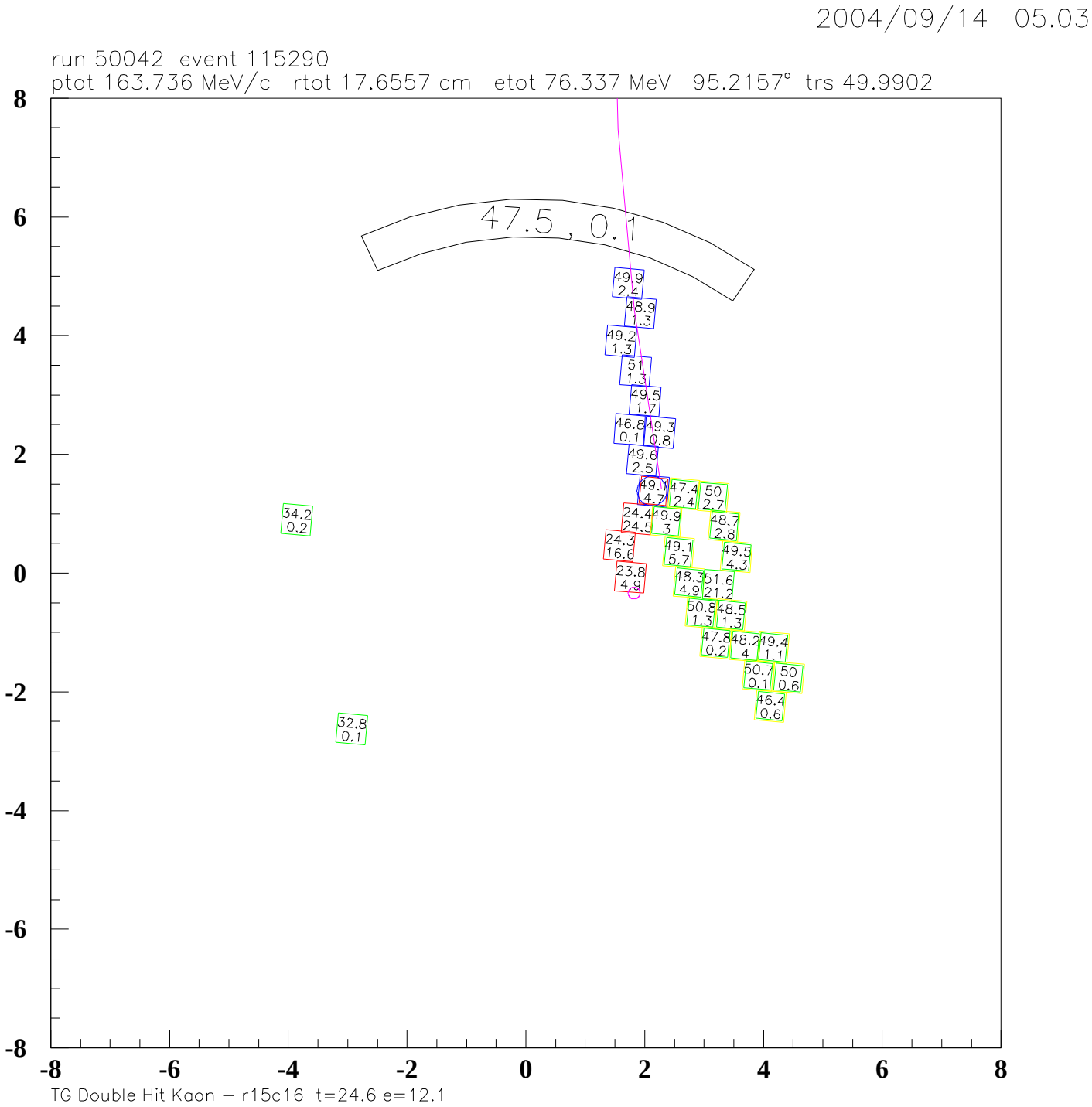
78M events out at pass1 $\rightarrow \sim 400k$ **TG scatters.**

Kinks that passed PV

Before...



After improvements



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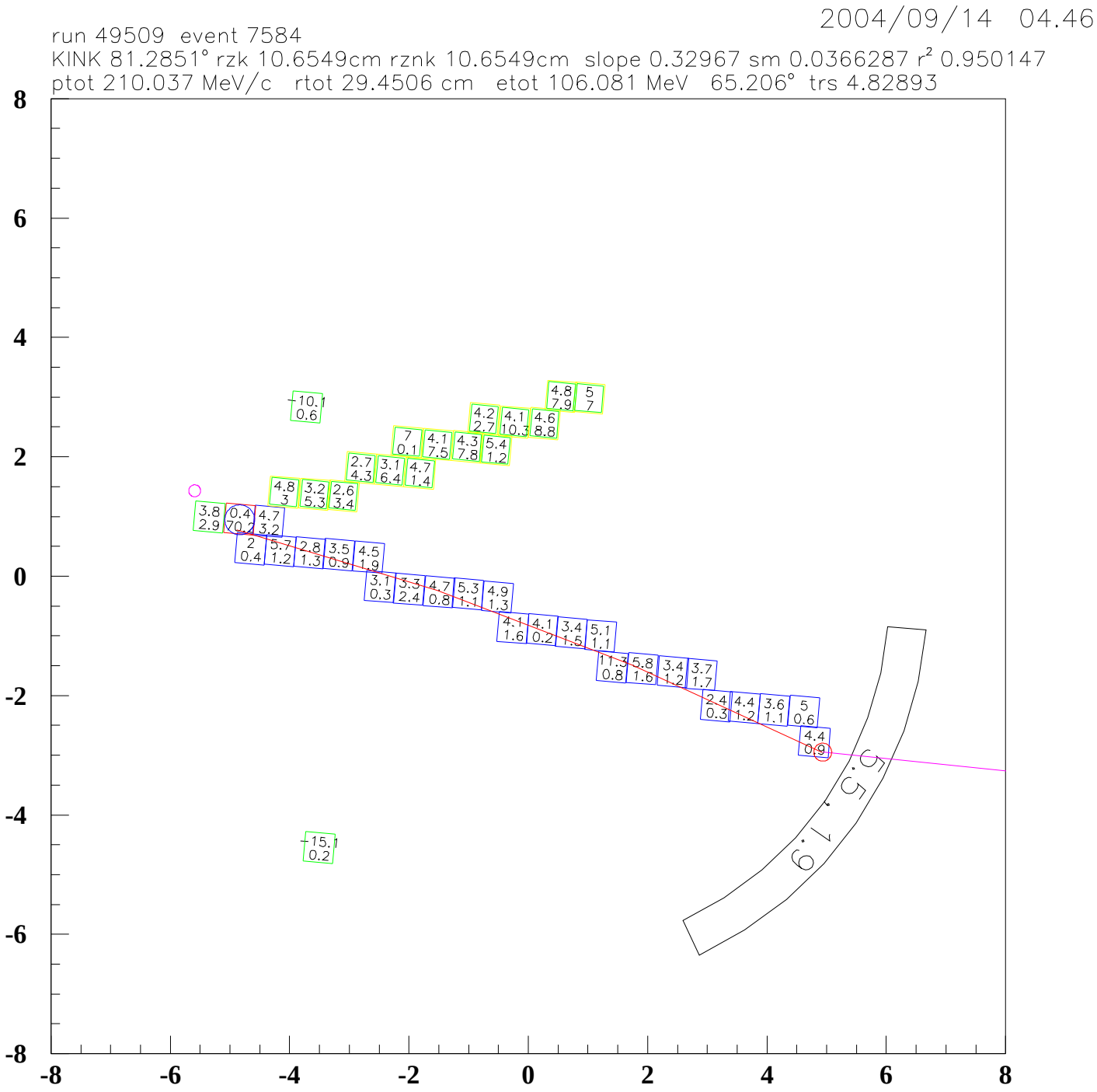

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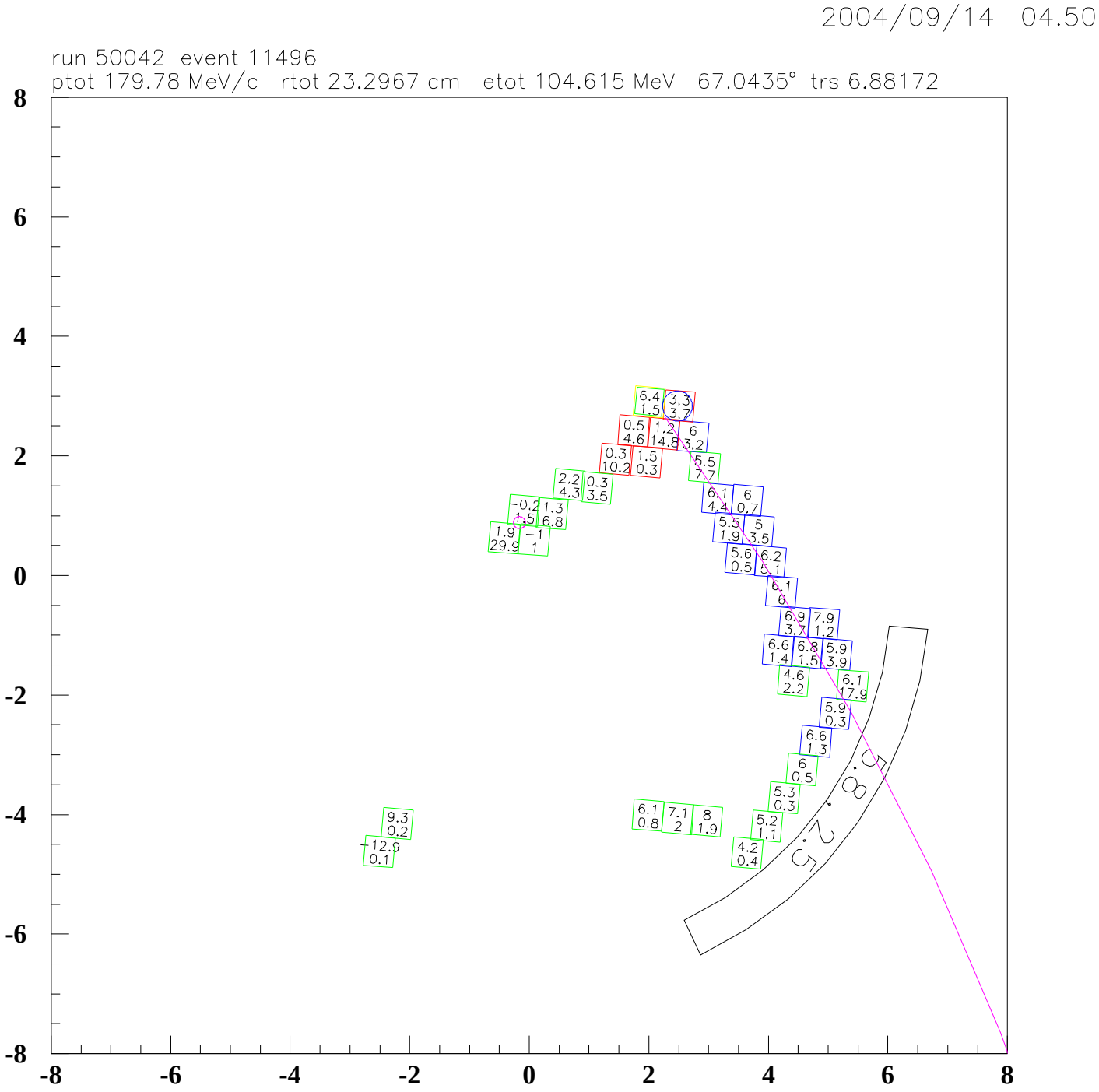

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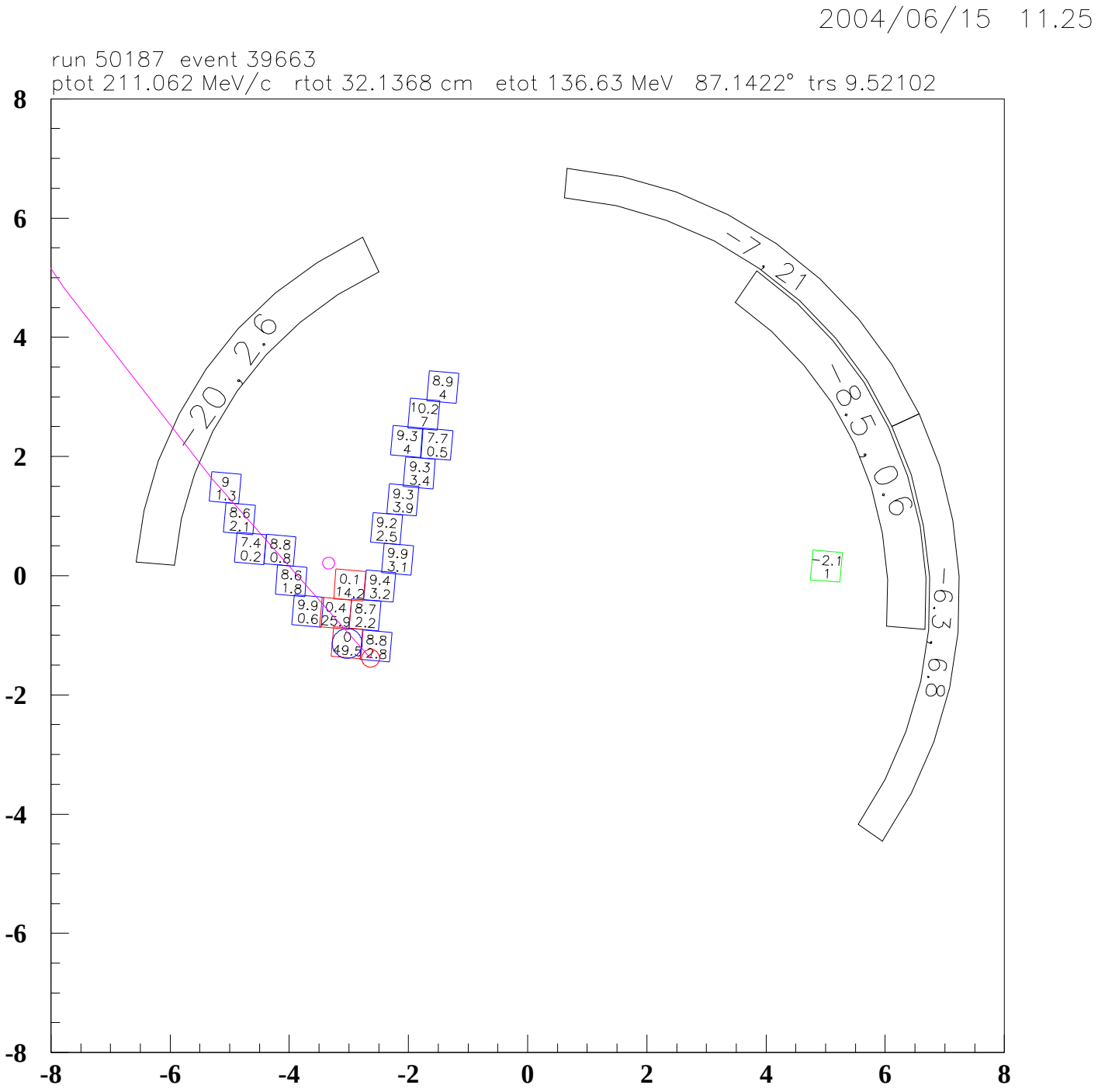

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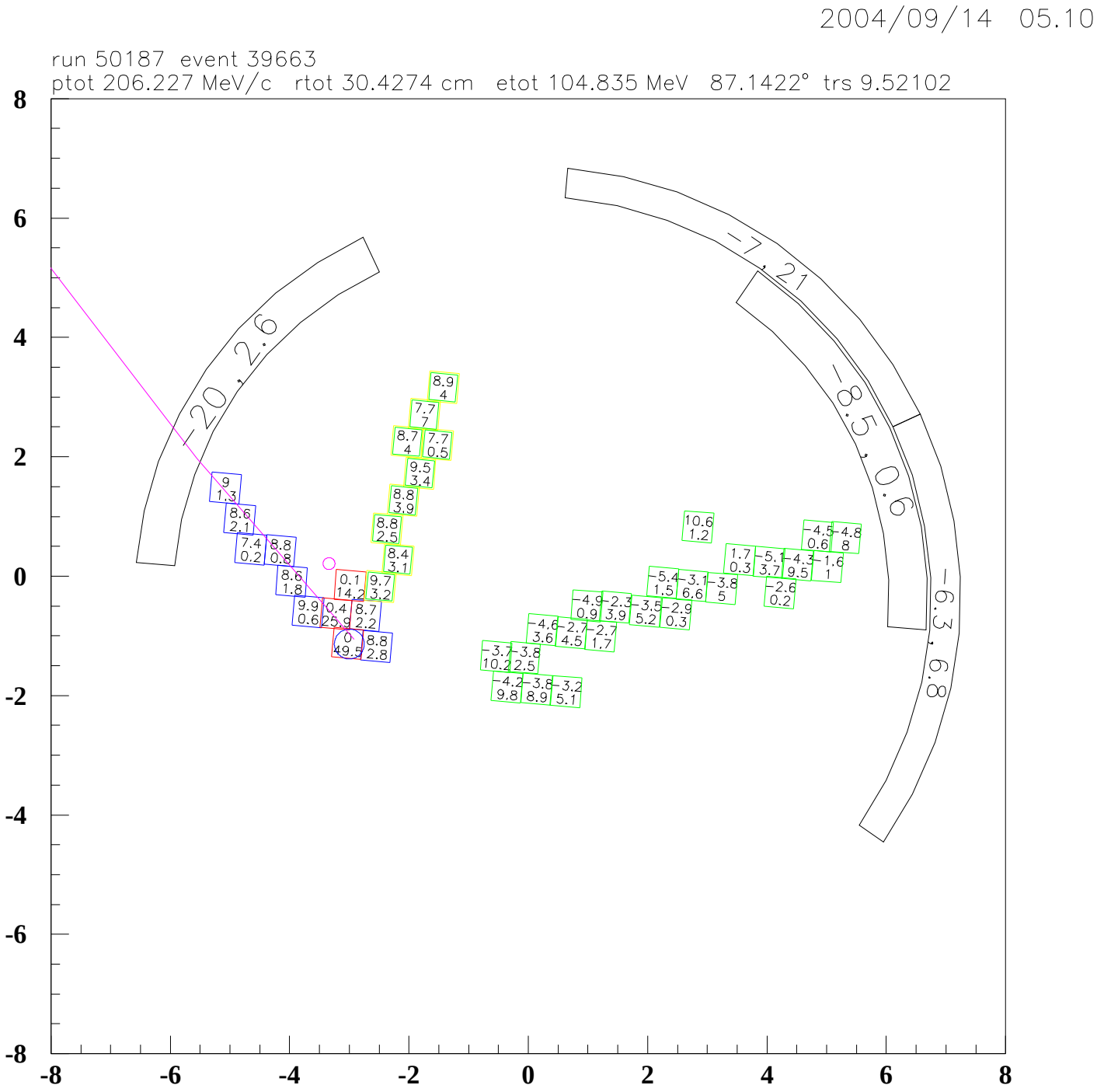

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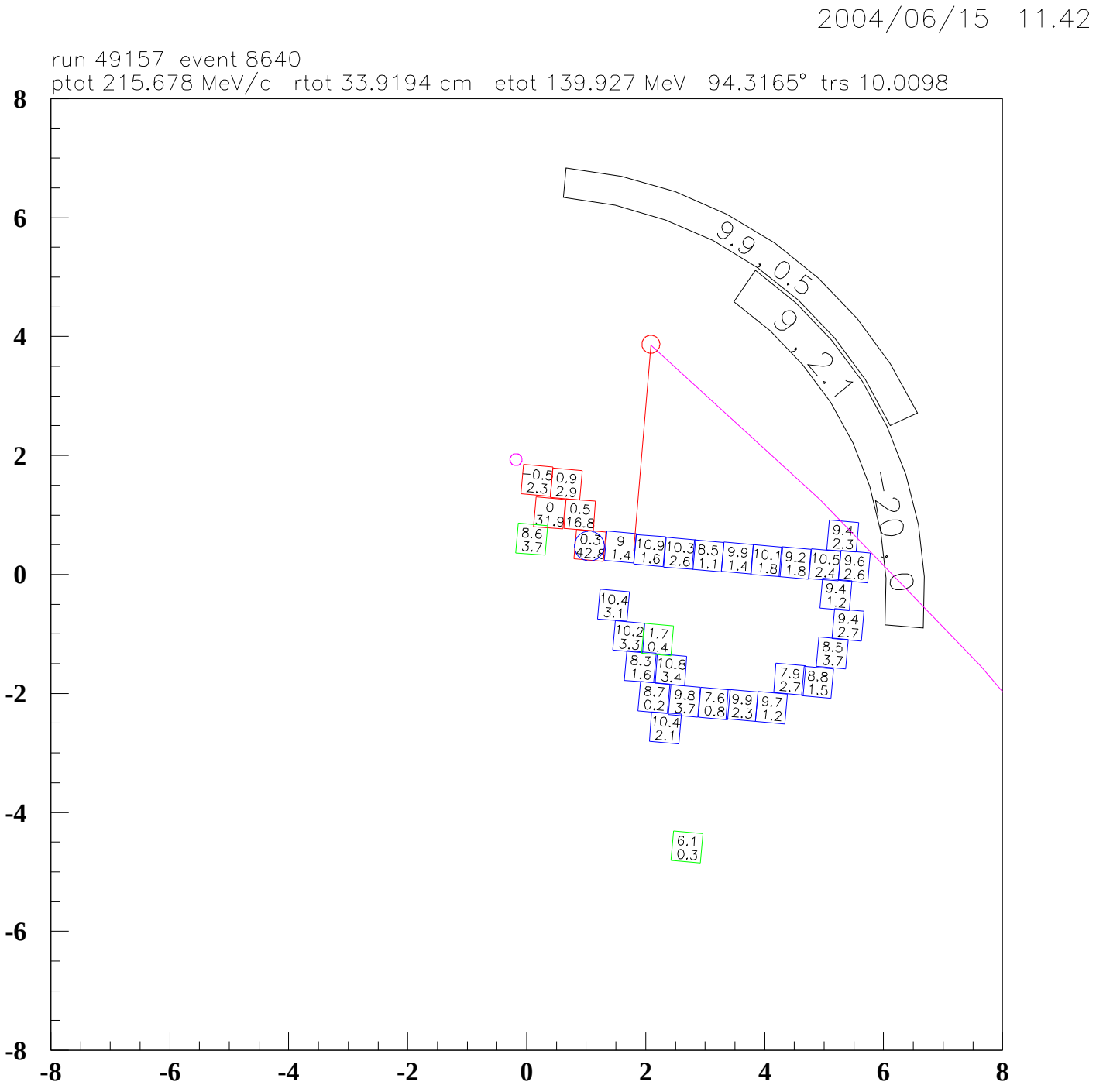

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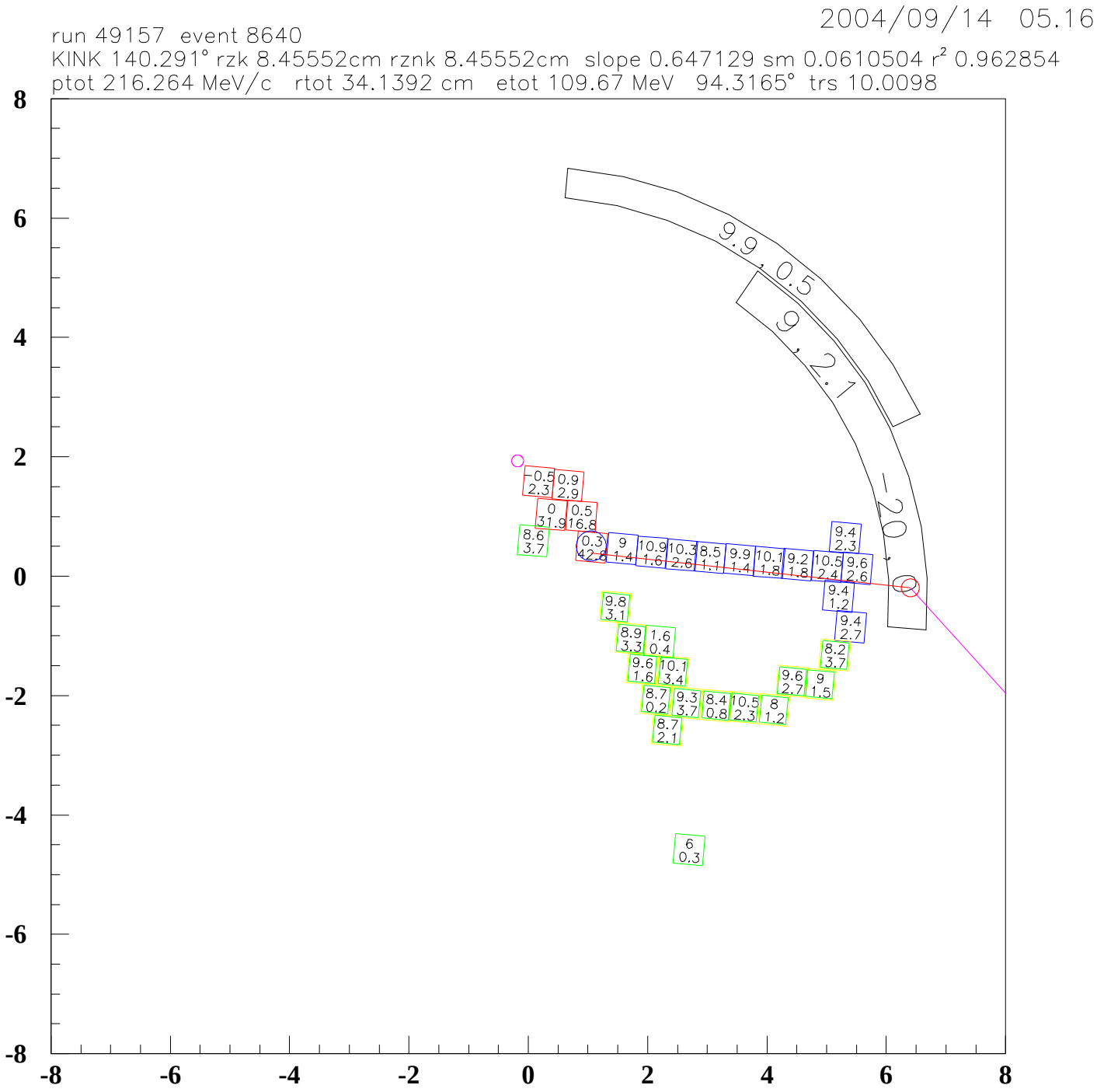

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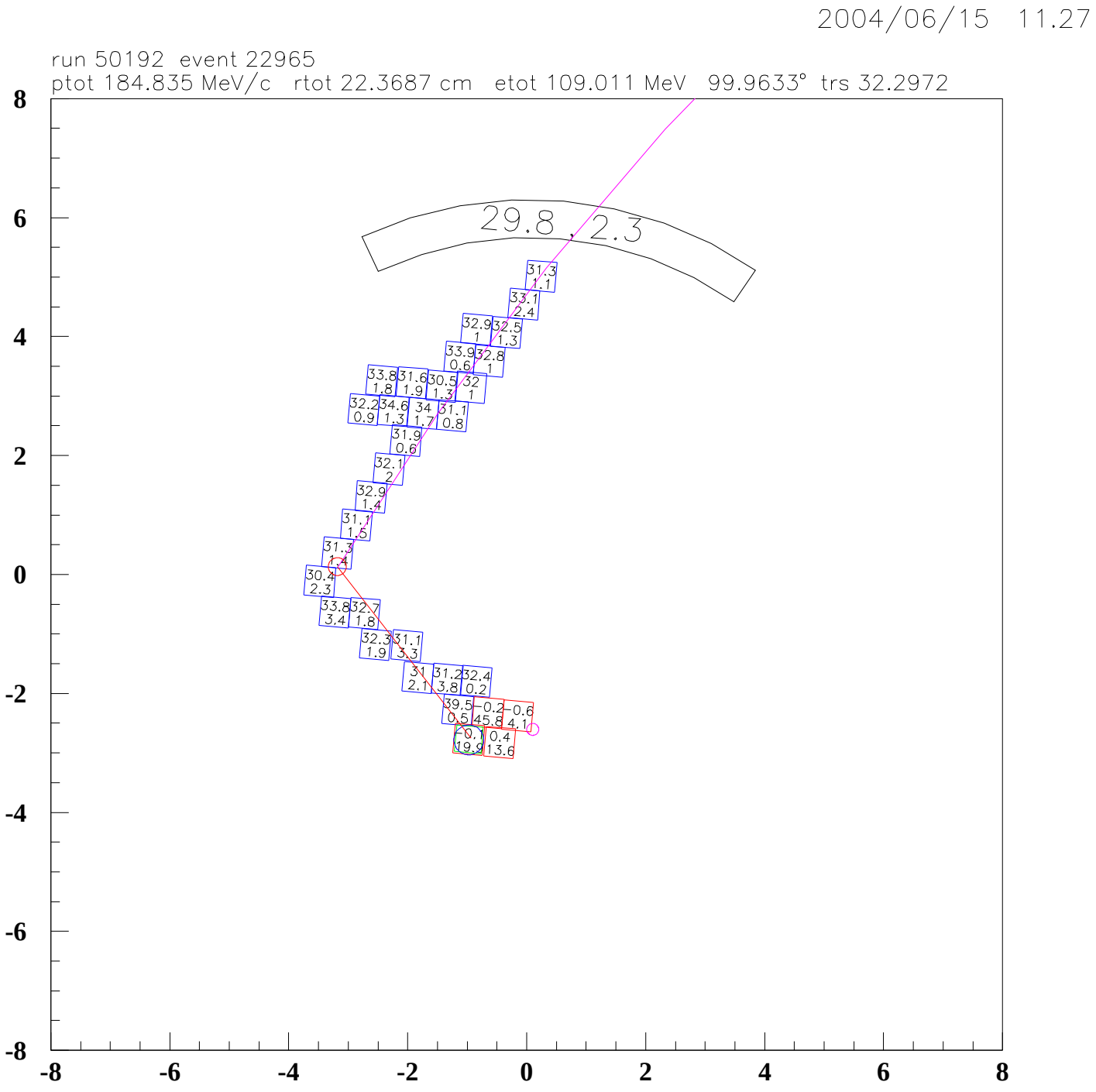

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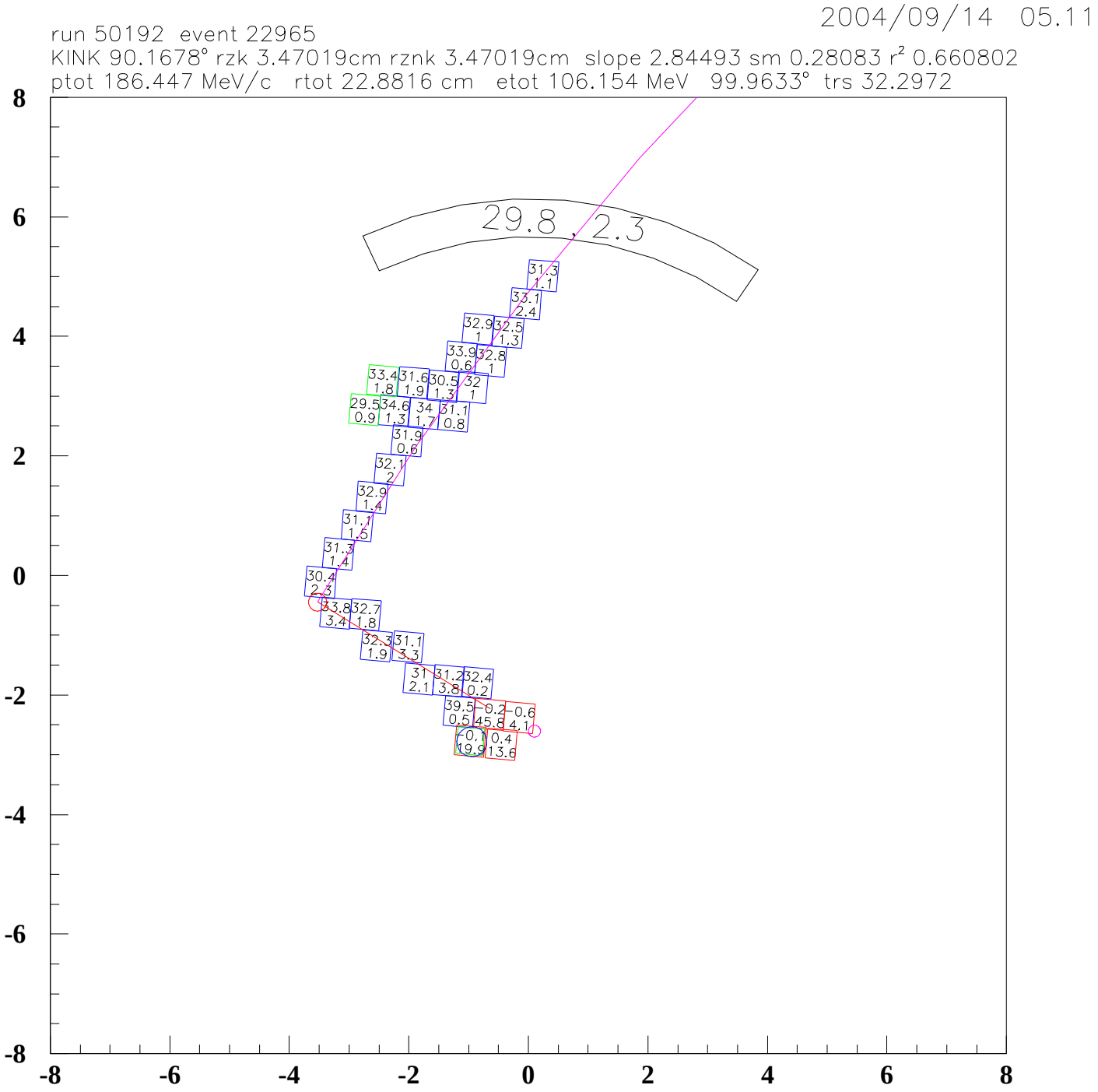

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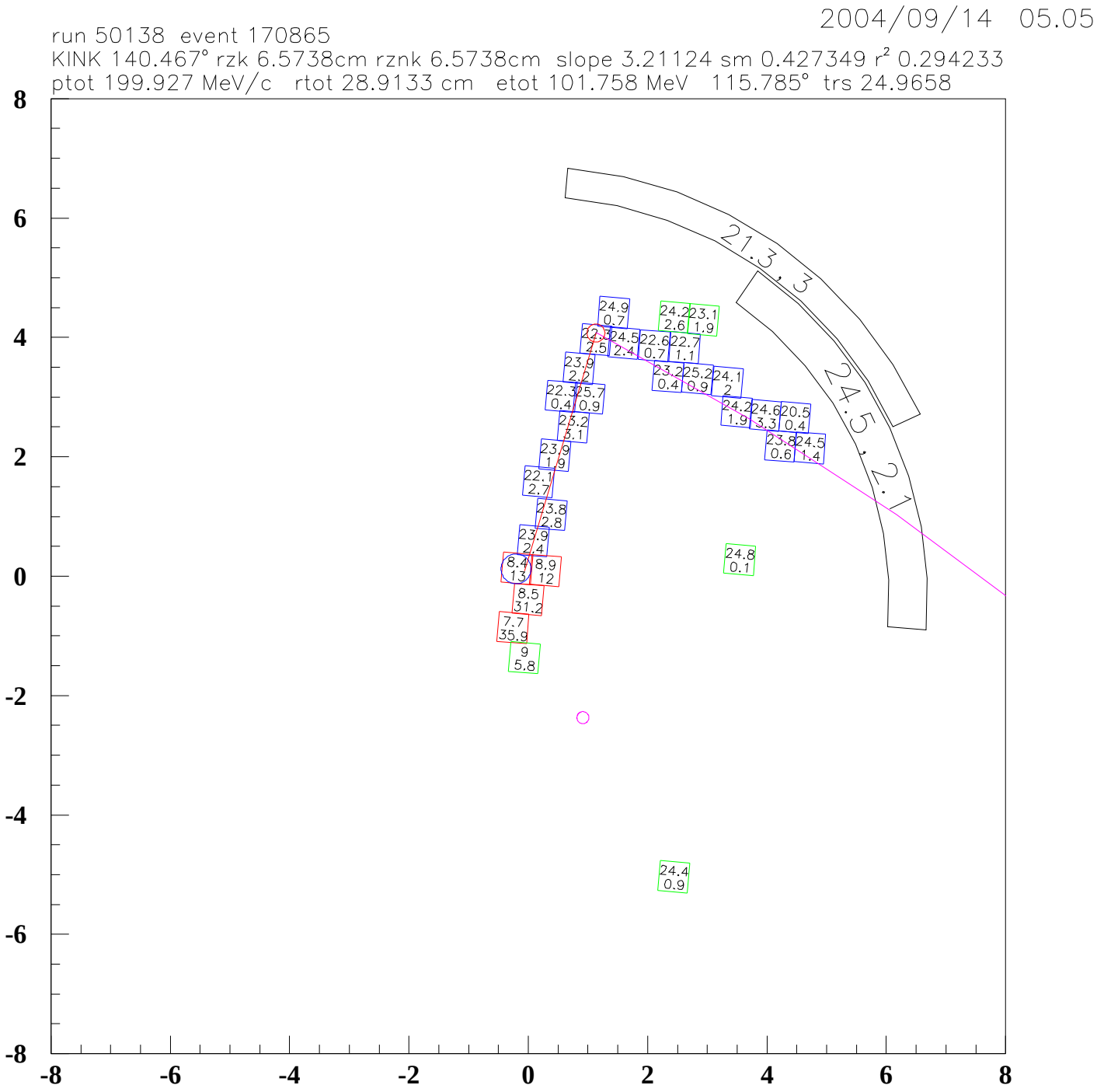

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